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CONTINUOUS RAILWAY BRAKES.

COPY OF CORRESPONDENCE

BETWEEN

THE BOARD OF TRADE AND THE RAILWAY COMPANIES ASSOCIATION,

AND

Returns from each of the several Railway Companies belonging to the Association, showing the steps taken by them for the Application of Continuous Brakes in Railway Trains.

Presented to both Houses of Parliament by Command of Her Majesty.

LONDON:
PRINTED BY GEORGE EDWARD EYRE AND WILLIAM SPOTTISWOODE,
PRINTERS TO THE QUEEN'S MOST EXCELLENT MAJESTY.
FOR HER MAJESTY'S STATIONERY OFFICE.

[C.—1775.] *Price 4d.* 1877.

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CORRESPONDENCE, &c.

Sir, Board of Trade (Railway Department), 25th July 1876.

With reference to the interviews between Mr. George Leeman and Sir Charles Adderley, on the subject of consultation on the part of the Board of Trade with representatives of the Railway Companies, in the case of special questions of difficulty or doubt which sometimes arise in connexion with the requirements of the Railway Inspecting Officers of the Board of Trade on the opening of new lines or branch railways, I am to suggest that Mr. Leeman should consider with the Association which he represents whether, when any such question of doubt or difficulty may arise, the Board of Trade might not ask him, as the Chairman of the Association, to name two or more persons whom he may judge well suited to assist the Board of Trade, and of high authority upon the special subject which forms the doubt or difficulty; and that these persons so nominated should meet such of their officers as the Board of Trade may appoint for the purpose, and discuss the point in question.

It is probable that the persons so named by the Association would be in each case a director of eminence, and, according to the merits of the case, an engineer, traffic manager, or working superintendent, &c., and that the Board of Trade would appoint one of their Secretaries or Assistant Secretaries and two or more of their Inspecting Officers.

It seems advisable that the results of any such discussion should be submitted to the President, to assist him in coming to a decision upon the point involved, and that the whole case, when settled, should be recorded at the Board of Trade and at the offices of the Association.

Such a course, it is suggested, would tend to produce satisfaction and agreement, by bringing into comparison the highest opinions of experts and officials, and thus build up certain recognised principles on disputed points, and so guarantee greater uniformity of practice.

I am, &c.,
(Signed) T. H. Farrer.

George Leeman, Esq., M.P.,
&c. &c.

The Railway Companies Association.

At a Meeting of the Association held on the 24th July 1876, the following Resolution was passed.

Read draft letter to the Chairman of the Association from the President of the Board of Trade, on the subject of occasional consultations between the Board of Trade and the representatives of Railway Companies.

Resolved that the Chairman and the Honourable Mr. Bruce communicate with Sir Charles Adderley the satisfaction of the Association with the proposed letter, and that when the same is sent it will be entered on the Minutes of the Association.

At a Meeting held on the 8th August 1876.

The letter from the Board of Trade, dated the 25th July 1876, was read, and ordered to be entered on the Minutes of the Association, in pursuance of the Resolution passed on the 24th July.

Sir, Board of Trade (Railway Department), 13th January 1877.

The Board of Trade proposed and the Railway Association agreed, in July last, that the Association should, in certain specific cases connected with railway working, in regard to which there might be difficulty or doubt, appoint two or more persons whom they might consider to be well suited and of high authority to meet and discuss such questions with officers to be appointed by the Board of Trade.

Having reference to this scheme, the Board of Trade direct me now to suggest to your Association that such a committee might, with great advantage, be appointed to consider the question of brake-power, as viewed by the light of recent experience.

The Board of Trade are aware that the proposal of July last had especial reference to cases in which they have specific statutory powers. But since the present case is one in which consultation and harmonious co-operation amongst the companies are requisite, and above all, since it is one in which the safety of the public is materially involved, it appears to this Board that the course which they have suggested might now with equal advantage be applied to the question of brake-power.

The general adoption of the most efficient form of brake-power is obviously important, both in the interest of the companies themselves and in that of the travelling public.

Great advance in the use of brakes has been made on the American and Continental railways; the experience derived from experiments made in this country is, by this time, considerable; and much loss of life and property (as shown in the case of recent accidents, and especially by Captain Tyler's Report, herewith enclosed, on the Arlesey accident,) has been occasioned from the want of more efficient brake-power.

The time has come for decisive and harmonious action; and if such action is to have all the advantages of which it is capable, it should be the result of combined consultation, so that each company and its officers may have the benefit of whatever information is to be derived from the experience of all.

The Board of Trade would willingly contribute to this object by offering to the companies the aid of some of their own officers to assist at such a consultation.

Should the Association concur in this proposition, the officers so appointed by the Board of Trade would meet the representatives of the Railway Companies in any convenient number that they might deem expedient.

I am, &c.,
(Signed) T. H. Farrer.

H. Oakley, Esq., Great Northern Railway,
King's Cross.

The Great Northern Railway, General Manager's Office,
King's Cross Station, London, N., 16th January 1877.

Sir,

I have the honour to acknowledge the receipt of your letter of the 13th instant, on the subject of a suggested conference between the officers of the Board of Trade and the representatives of Railway Companies, with the view of securing combined and harmonious action on the important question of the provision of increased brake-power to passenger trains.

I will immediately submit the letter to Mr. Leeman, the chairman of our Association, and shall have the honour of communicating with you further.

I am, &c.,
H. Oakley.

T. H. Farrer, Esq.,
Board of Trade (Railway Department),
Whitehall.

The Great Northern Railway, General Manager's Office,
King's Cross Station, London, N., 21st February 1877.

Dear Sir,

Your letter of the 13th January, on the subject of brake-power, was brought before the first meeting of the Railway Companies Association to-day, and I am instructed to forward a copy of your letter to all the Railway Companies parties to the Association, and to convene a special meeting to consider the subject in a fortnight from this date.

After that meeting, I shall have pleasure in again communicating with you.

Yours, &c.,
H. Oakley.

T. H. Farrer, Esq.,
Railway Department, Board of Trade.

The Railway Companies Association Offices,
28, Great George Street, Westminster,
April 18th, 1877.

SIR,

THE Railway Companies Association has had under their consideration Mr. Farrer's letter of the 13th January to Mr. Oakley, the honorary secretary of the Association, suggesting that a consultation between the officers of Railway Companies and those of the Board of Trade should be held, with the view to secure, by combined action, the adoption of the most approved form of brake-power in trains.

My colleagues in the Association desire me, in the first place, to express their cordial appreciation of, and to thank you for, your considerate and practical suggestion, and to place before you, generally, the efforts the companies are making to attain the object suggested in Mr. Farrer's communication.

The principal railway companies are, and have been for some time past, engaged in testing, in daily practice, one or other of the most suitable forms of continuous brake. Such brakes are already largely applied to express and other trains in some of the principal through lines of the country, and are in actual and serviceable use daily.

In addition to this direct and practical trial, all the companies whose names are given hereunder, representing four-fifths, or about 12,000 miles, of the whole passenger mileage, are testing, in the common interest, and with the object of elucidating the action of continuous brakes under all conditions, one or more of the brakes given in the subjoined list.

The names of the companies, and the brakes under trial, are as follows:

Bristol and Exeter
Caledonian
Glasgow and South-western
Great Eastern
Great Northern
Great Western
Lancashire and Yorkshire
London, Brighton, and South Coast
London, Chatham, and Dover
London and North-western
London and South-western
Manchester, Sheffield, and Lincolnshire
Metropolitan
Metropolitan District
Midland
North British
North-eastern
North London
North Staffordshire
South Devon
South-eastern
Trent, Ancholme, and Grimsby
West Riding and Grimsby

Clarke and Webb.
Westinghouse.
Smith's Vacuum.
Barker's Hydraulic.
Newall and Fay.
Steel and McInnes.
Sanders.
Heberlein.

As at present advised, it does not appear to the companies essential that one form of brake should be universally adopted, but with the view to secure a general interchange of practical knowledge on the subject, the experience gained by the companies is freely communicated to each other from time to time.

Many of the systems afford sufficient arresting power, but reliable conclusions relative to the endurance of the machinery, the facility of application, and certainty of action, can only be formed after further trials and continuous use in daily practice.

The directors of the associated companies beg me, therefore, respectfully to assure you that they are fully impressed with the public importance of the subject on which you have communicated with them, and they propose to continue their efforts to obtain and apply the most effective forms of controlling power that will sufficiently meet the varied needs of the railway traffic of the country.

I have, &c.,
GEO. LEEMAN,
Chairman.

The Right Honourable
Sir C. B. Adderley, M.P., K.C.M.G.,
President of the Board of Trade.

Sir, Board of Trade (Railway Department), 21st April 1877.

I am directed by the Board of Trade to acknowledge the receipt of your letter of the 18th instant, respecting the use of brake-power.

The Board of Trade are glad to learn from your letter that steps are being taken by the railway companies to improve brake-power, and to test the merits of the various forms of brakes. But they are at the same time of opinion that your letter does not give such information on the subject as the Board of Trade desire to learn, or as would be thought satisfactory if presented to Parliament. It is general in its terms, and fails entirely to show what experiments have been or are being made, what the results of those experiments have been, what further experiments are contemplated, and what progress has been made in the actual adoption of improved brakes. Above all, it fails to show what part each separate company has taken in these experiments and improvements.

Looking to the Report of the Royal Commission on Railway Accidents, and to the experiments conducted by them, it seems desirable that the information contained in the annexed statement should be published, for the purpose of showing that the railway companies have realised the urgency that exists for efficient and united action in this matter. They would, therefore, be glad to know, at your earliest convenience, whether your Association is able to furnish them with the desired information.

It is scarcely necessary to repeat, as was stated to your deputation on the 18th instant, that the evidence given to the Duke of Somerset's committee concerning the progress made by the railway companies in adopting the special improvements then under consideration, were regarded by that committee as sufficient reasons for not recommending compulsory legislation.

I am, &c.,
(Signed) Edward Stanhope.

George Leeman, Esq., M.P.,
Chairman of the Railway Companies Association,
28, Great George Street, Westminster.

Memorandum.

Information to be obtained from each company separately:—

1. Whether any, and what, experiments have been tried with continuous brakes?
2. With what description of brakes?
3. Where and when?
4. What are the results?
    - *a.* As to efficiency in stopping trains, and especially whether the brakes can be applied instantaneously, and whether, in case of accident, they are self-acting?
    - *b.* As to facility of putting on and taking off the brakes?
    - *c.* As to their maintenance and durability?
5. Are any further experiments contemplated, and, if so, whether any further reports may be expected, and when?
6. What progress has been made in the actual fitting up of engines and carriages with continuous brakes, stating the number of engines and carriages separately?
7. On what trains are any such brakes in use, specifying the description of trains and the description of brake?
8. What steps have been taken, as stated in your letter, for making the experience of one company available by another?

The Railway Companies Association Offices,
28, Great George Street, Westminster,
April 23rd, 1877.

Sir,

I have the honor to acknowledge the receipt of your letter of the 21st instant, in reply to mine of the 18th.

My letter to Sir Charles Adderley of the latter date was written with the view of showing that the companies named therein were fully alive to the desirability of improving their brake-power in trains.

They know, however, by experience in analagous improvements in railway appliances that a thoroughly efficient brake cannot be improvised at will, or without a series of costly and exhaustive trials and experiments. These have been diligently pursued by many of the companies.

We will endeavour to obtain details of these experiments from each company, but some little time must unavoidably elapse before the information can be obtained, and compiled for you.

No avoidable loss of time shall however occur.

I am, &c.,
GEORGE LEEMAN.

The Honorable Edward Stanhope, M.P.,
Board of Trade.

At a MEETING of the RAILWAY COMPANIES ASSOCIATION, held at No. 28, Great George Street, Westminster, on Tuesday, the 8th day of May 1877, Mr. LEEMAN, M.P., in the Chair.

The Chairman read a letter from The Right Honourable Sir C. B. Adderley, M.P., stating that he, and some of the officers of the Board of Trade, intended to inspect the continuous brakes in operation upon the Midland Railway.

Resolved, that the Chairman be requested to inform Sir Charles Adderley that all the companies represented in the Association will be happy to give him any opportunity he may desire of inspecting the continuous brakes in operation, or under trial, on their respective systems.

H. OAKLEY, Hon. Secy.

Board of Trade (Railway Department),
15th May 1877.

SIR,

I AM directed by the Board of Trade to acknowledge the receipt of, and to request that you will express their thanks for, a copy of a resolution passed at a meeting of the Railway Companies Association, stating that all the companies represented in the Association will be happy to give Sir C. Adderley any opportunity he may desire of inspecting the continuous brakes in operation or under trial on their respective systems.

I am, &c.,
(Signed) HENRY G. CALCRAFT.

H. Oakley, Esq.,
Railway Companies Association,
28, Great George Street, S.W.

Board of Trade (Railway Department),
15th May 1877.

SIR,

I AM directed by the Board of Trade to transmit the accompanying copy of a notice of motion given by the Duke of Somerset in the House of Lords for a return showing the progress made in the adoption of additional brake-power by the railway companies of the United Kingdom, and to request that you will call the attention of the Railway Association to the same.

I am at the same time to point out that it is most essential that the Board of Trade should be in a position to lay the required information before Parliament with the least possible delay.

I am, &c.,
(Signed) HENRY G. CALCRAFT.

H. Oakley, Esq.,
Railway Companies Association,
28, Great George Street, S.W.

The Great Northern Railway, General Manager's Office,
King's Cross Station, London, 18th May 1877.

SIR,

IN acknowledging the receipt of your letter of the 15th inst., transmitting the copy of notice of motion given by the Duke of Somerset in the House of Lords, I have much pleasure in sending you herewith, a return showing the steps taken by each of the several railway companies parties to the Association, and whose names, for convenience, I have given annexed, relative to the application of continuous brakes in trains.

This information has been obtained from each of the companies, with a view to furnish the information asked for by your letter of the 21st April last. I have not attempted any compilation of the information furnished, as each company has adopted its own course with a view to obtain information for itself, and the advantages of this course are, I think, fully evidenced by the variety of experiments, and the different class of brakes tried by the several companies.

If on examination of the papers you think them deficient on any point, and will let me know, I shall be happy to obtain such further particulars as you may require.

I have, &c.,
H. OAKLEY.

H. G. Calcraft, Esq.,
Board of Trade, Whitehall, S.W.

LIST of RAILWAY COMPANIES constituting the RAILWAY COMPANIES ASSOCIATION.

1. Caledonian.
2. Furness.
3. Glasgow and South-western.
4. Great Eastern.
5. Great Northern.
6. Great Western.
7. Highland.
8. Lancashire and Yorkshire.
9. London, Brighton, and South Coast.
10. London, Chatham, and Dover.
11. London and North-western.
12. London and South-western.
13. Manchester, Sheffield, and Lincolnshire.
14. Metropolitan.
15. Midland.
16. North British.
17. North-eastern.
18. North London.
19. North Staffordshire.
20. South-eastern.

SIR, Board of Trade (Railway Department), 19th May 1877.

I AM directed by the Board of Trade to acknowledge the receipt of your letter of the 18th instant, enclosing, in accordance with the request contained in the letter from this Department of the 21st ultimo, a return showing the steps taken by each of the several Railway Companies parties to the Association relative to the application of continuous breaks in railway trains.

In thanking the Railway Companies Association for the trouble they have taken in obtaining this information, I am at the same time to state to you, for their information, that the Board of Trade will lay the same before Parliament as soon as possible.

I am, &c.,
(Signed) HENRY G. CALCRAFT.

H. Oakley, Esq.,
Great Northern Railway,
King's Cross Station, N.

QUESTIONS.

1. Whether any and what experiments have been tried with continuous brakes?
2. With what description of brakes?
3. Where and when?
4. What are the results?
    - *a.* As to efficiency in stopping trains, and especially whether the brakes can be applied instantaneously, and whether in case of accident they are self-acting.
    - *b.* As to facility of putting on and taking off the brakes.
    - *c.* As to their maintenance and durability.
5. Are any further experiments contemplated, and if so, whether any further reports may be expected, and when?
6. What progress has been made in the actual fitting up of engines and carriages with continuous brakes, stating the number of engines and carriages separately?
7. On what trains are any such brakes in use, specifying the description of trains and the description of brake?
8. What steps have been taken, as stated in your letter, for making the experience of one company available by another?

RAILWAY COMPANIES ASSOCIATION.

Returns showing the steps taken by the several Companies composing the Association relative to the application of Continuous Brakes in Trains, in reply to the Board of Trade letter of the 21st April 1877.

Caledonian Railway Brake Power.

1. Yes, on passenger trains with the Westinghouse, the Steel-McInnes, and the Clark and Webb's brakes.

2. With Westinghouse ordinary, Steel-McInnes' automatic, and Clark and Webb's chain brake.

3. Westinghouse on the Wemyss Bay Line during the last six years; Steel-McInnes' on the Edinburgh and Glasgow Line during the last two years; and Clark and Webb's on the passenger trains between England and Scotland, by the Caledonian and London and North-western Railways (known as the West Coast Route), during the last year.

4 (*a.*) The brakes are efficient in stopping the trains, and can be applied instantaneously. The Steel-McInnes is the only one which is self-acting.

4 (*b.*) The putting on and taking off of the brakes is done with facility.

4 (*c.*) The maintenance of the brakes as yet has not been very costly, and the machinery has continued in good order, with the exception of the brake blocks.

5. Yes, we are fitting up two trains of the Westinghouse automatic brake, and we propose to fit up a train with Clark and Webb's automatic chain brake, and to test them carefully in daily use, till we can speak confidently as to their merits.

6. Two engines and 20 carriages have been fitted with the Westinghouse ordinary brake; two engines and 13 carriages have been fitted with the Steel-McInnes' brake; and 11 carriages have had the chain connexion for Clark and Webb's brake applied to them; 108 West Coast Joint carriages have been fitted with Clark and Webb's brake complete, and six carriages have been fitted with the chain connexion only.

7. They are in use on passenger trains as follows, viz., Westinghouse on the Wemyss Bay Line; Steel-McInnes' on the Edinburgh and Glasgow Line; Clark and Webb on the through trains between England and Scotland by West Coast Route (London and North-western and Caledonian).

8. By making inquiry personally, by letter, and the reading of public records of experiments made by various companies from time to time.

THE FURNESS RAILWAYS.

Barrow-in-Furness, Lancashire,
April 28th, 1877.

DEAR SIR,

IN reply to your letter of the 23rd instant, I beg to inform you that the Furness Railway Company has not yet adopted any kind of continuous brake. My directors are, however, quite alive to the importance of having such brakes attached to their trains, and they have been making inquiries as to the result of experiments made by the larger Railway Companies with whose lines the Furness Railway connects, and my directors will be prepared to adopt the brake which may finally be decided upon as the best by the London and North Western or the Midland Company.

I am, &c.
(Signed) for H. COOK,
C. M.

H. Oakley, Esq.,
General Manager,
Great Northern Railway,
King's Cross Station, London.

GLASGOW AND SOUTH-WESTERN RAILWAY.

1. Continuous brakes have been in use on the express trains to the south on this line since August last.
2. The Westinghouse continuous automatic air brake.
3. Between Glasgow and Carlisle, since August last.

4 (*a.*) This brake is efficient in stopping trains. Can be applied instantaneously from engine or brake-vans. Is self-acting until such time as the compressed air is exhausted from the magazine under each vehicle.

4 (*b.*) Easily put on and taken off.

4 (*c.*) The brake has not been in use on this railway sufficiently long to enable us to answer this question.

5. No, beyond ordinary working.
6. Twenty engines fitted, and two engines and 20 carriages are being fitted.
7. See answers to Nos. 1 and 2.

GREAT EASTERN RAILWAY.

Stratford Works, April 30th, 1877.

ANSWERS to QUESTIONS given by the Railway Department of the Board of Trade, 30th April 1877.

1. The Great Eastern Railway have not run special experimental trips with brake trains, and the knowledge we have concerning the efficiency of the particular brake used has been simply that gained by us in actual practice.
2. The brakes we have in use are—Smith's vacuum, Barker's hydraulic, Clark's chain, also Wilkin and Clark's, and Fay's hand brake.
3. The above are in daily operation.

4 (*a.*) We have found Barker's brake the quickest in stopping.

We find practically we can stop in about two platform lengths, at the usual working speed, with Smith's.

Barker's brake can be applied instantaneously, as the power is always accumulated.

Smith's requires a vacuum to be formed, which takes a trifle longer than Barker's to bring the brake into full operation.

In case of accident, none of the arrangements we have in use are self-acting, though we are now fitting an arrangement to Smith's brake which will be automatic in case of break-away.

4 (*b.*) The application of Barker's brake requires only pulling forward a handle, which is returned to its original place to take the brakes off, and is operated easily with one hand.

Smith's requires even less trouble than this, though in this brake there are two handles, one to put steam on and the other to destroy the vacuum.

Clark's requires a little trouble, as the friction pullies have to be pressed tight against each other to prevent slipping.

With Fay's the brake is screwed on all along the train from one hand wheel, and requires more exertion than any of the others we use.

4 (*c*.) We find Smith's brake cheapest for maintenance, Clark's comes next, and Barker's most expensive.

As we have Fay's brake in only one section on three carriages, we have not had sufficient experience to justify our saying much about it, but we may mention that it has given no trouble since it has been running.

5. We are simply continuing to use the above, with any improvement we see our way to make, until more information and experience has been acquired.

6. There are now in daily running, fitted with—

Smith's brake.—Carriages,	75.	Engines, 11.
Clark's ,, ,,	27.	,, Nil.
Barker's ,, ,,	49.	,, ,,
Fay's ,, ,,	3.	,, ,,

	No. of Trains.	Vehicles per Train.	Total No. of Vehicles.
7. Walthamstow Branch, vacuum	4	13	52
Enfield Branch, hydraulic	4	10	40
	1	9	9
,, ,, chain	2	4	8
,, ,, ,,	1	6	6
Loughton Branch	2	4	8
	1	2	2
St. Pancras Branch, Fay's	1	3	3
4.45 p.m., Liverpool Street to Ipswich, express 8.20 a.m., Ipswich to Liverpool Street	Vacuum. 1	10	10
5.10 p.m., London to Norwich, express 7.30 a.m., Norwich to London ,,	1	13	13
5.10 p.m., Norwich express, Bishop Stortford, slip carriages, chain	—	3	3
Total			154

Passenger tank engines	5
,, tender ,,	6
Total fitted with vacuum brake	11

8. We have given every facility for the inspection of our brakes, and have availed ourselves from time to time of the opportunities of inspecting those of other companies.

GREAT NORTHERN RAILWAY.

ANSWERS to QUESTIONS in Mr. Stanhope's letter to George Leeman, Esq., M.P., Chairman of the Railway Association.

1. Many experiments have been made, and several trains have been running for many months; one on the Metropolitan and Suburban service for about two years.

2. With Smith's vacuum brake chiefly; one train has been fitted with Clarke's brake.

3. At Doncaster, and at dates given in list of trials appended to No. 4.

4 (*a*.) The vacuum brake has been giving great satisfaction in practice. The efficiency in stopping trains admits of no doubt, as will be gathered from the list of experiments given below. The brakes can be instantaneously applied, without shock to the passengers, and can be made self-acting in cases of accident.

4 (*b*.) The brake is put on by an engine-driver by opening a steam tap. It can also be put on by the guards, or any passenger in the train, if thought necessary. The brake can be taken off in two or three seconds, and never fails to come off.

4 (*c.*) So far as present experience goes, the brake will be very easily maintained. None of the sacks have failed from tear and wear, and the pipes and couplings being perfectly free from pressure, except when the brakes are put on, the durability of them is certain.

5. Constant experiments are being made, and the adaptation of the principle to engines and carriages is progressing steadily, and the result of such progress can be given at any future time.

6. This Company have already in operation 50 engines fitted with the vacuum brake, and 168 carriages, and 10 more engines will be fitted shortly, and the carriages as fast as the materials can be got. Also 12 carriages have been fitted with the chain brake.

7. Smith's vacuum brake is running daily on seven express trains in each direction, between London and Manchester and Yorkshire. The chain brake is running daily to Cambridge and back, and another section to Boston and back.

8. By frequent communication, and inquiries and replies, between the officers of the several companies.

List of Trials made with Smith's Vacuum Brake on Great Northern Railway.

Description of Train.	Gradient.		Speed in Miles per Hour.	Distance run after application of Brakes.	Time in Seconds making Stop.	Total Weight, including Engine and Tender.	Date of Trial.	Where Trial took place.	Remarks.
				Yards		Tons cwts. qrs.			
Thirteen carriages, two luggage vans, 7-ft. passenger engine uncoupled, and six-wheeled tender; brake applied to engine and tender.	1 in 198	Falling	56	356	21	217 10 3	March 1876	Lincolnshire Loop, between Doncaster and Lincoln.	
	1 „ 1,100	Rising	40	153	17				
	1 „ 400	Falling	50	257	16				
	1 „ 1,100	Do.	45	271	23				
	1 „ 198	Do.	60	346	23				
Eight carriages, two luggage vans, 7-ft. single passenger engine and tender; brake applied to engine and tender.	Level	- -	47	247	18	162 5 2	March 1876	Lincolnshire Loop, between Doncaster and Lincoln.	
	Do.	- -	60	352	22				
	1 in 400	Rising	55	246	20				
	Level	*	47	388	23				*Connecting pipes open at tail ends.
	1 in 400	Falling	45	253	20				
	1 „ 660	Rising	56	346					
Eleven carriages, two luggage vans, 7-ft. single passenger engine and tender; brake applied to engine and tender.	1 in 200	Falling	47	312	21	194 19 0	March 1876	Cambridge Branch.	
	1 „ 200	Rising	34	187	17				
	1 „ 1,467	Falling	60	331	22				
	1 „ 200	Do.	52	299	21				
	1 „ 200	Do.	63	392	24				
Ten carriages, two luggage vans, 7-ft. single passenger engine and tender; brakes applied to engine and tender.	Level	- -	50	310	18	190 12 3	May 1876	Lincolnshire Loop, between Doncaster and Lincoln.	
	1 in 200	Falling	60	410	22				
	1 „ 176	Do.	56	320	20				
	1 „ 400	Do.	56	294	20				
Ten carriages, two luggage vans, 7-ft. single passenger engine and tender; brakes applied to engine and tender.	1 in 200	Falling	60	412	24	165 5 3	March 1877	Lincolnshire Loop, between Doncaster and Lincoln.	
	1 „ 400	Do.	62	381	27				
	Level	- -	53	311	22				
	1 in 400	Falling	54	339	22				
Clark's Chain Brake.									
Ten carriages, two luggage vans, 6-ft. 6-in. coupled engine and tender; brake applied to all wheels of train.	1 in 198	Falling	50	450	33	185 8 2	March 1877	Main line between Doncaster and Peterborough.	Tender hand brake used with chain brake.
	1 „ 200	Do.	62	685	41				Ditto Ditto
	Level	-	50	694	50				Ditto Ditto
	Do.	*	56	376	27½				*Vacuum brake applied to engine and tender in this stop.

GREAT WESTERN RAILWAY.

1 and 2. Experiments have been tried, both by special trips and in ordinary working, with Clark's, Fay's, Newall's, Barker's hydraulic, and Smith's vacuum, and Grove's brakes, but it is not proposed to extend the use of any of these forms.

Clarke's brake was at one time applied to 24 broad gauge and 20 narrow gauge carriages satisfactorily.

Fay's and Newall's brakes were tried for some time on the West Midland section of the line.

Barker's hydraulic brake was tried on the Monmouthshire section.

Smith's vacuum brake, which is fitted to 10 engines and 63 passenger vehicles, for ordinary stops.

Grove's brake was fitted to three broad gauge carriages.

The answers to the following questions refer only to Sanders' vacuum brake, which this Company is at the present time using experimentally.

A lithograph of the brake is sent herewith.

3. *Sanders' brake* has been tried on the main line between Swindon and Didcot, and between Swindon and Taunton; the experimental train is still running between Swindon and Taunton.

4 (*a.*) This brake, *so far*, appears likely to work better than any of those we have tried. It can be applied instantaneously, and in case of accident is self-acting.

4 (*b.*) The engineman can put on and take off the brake by moving a handle, which requires only a light touch. The guard also can put on the brake in like manner, but the engineman only can take it off.

4 (*c.*) The brake appears, so far, to compare favourably with any we have hitherto tried in these respects.

5. Several other trains are being fitted up for further trial, in ordinary working, but we cannot yet fix a time when we shall be able fully to report upon the results.

6. See reply to question 5.

One engine and six carriages are at present working. 12 engines and 36 carriages are being fitted up with the brake, and it is expected that some of them will be at work this month. A steam brake, however, is in course of being applied to about six engines and tenders; the brake will block two pairs of the engine and all the tender wheels.

7. See previous answers.

8. The brakes in use on the London and North-western, Midland, Great Eastern, North-eastern, North British, and other railways have been examined on behalf of this Company, and information has been exchanged with the heads of the Rolling Stock Departments of these Companies. Some of the principal officers of this Company were present at the experiments at Newark.

HIGHLAND RAILWAY.

The Highland Railway Company,
General Manager and Secretary's Office,
Inverness, 30th April 1877.

DEAR SIR,

I HAVE your circular, dated 23rd instant, on this subject, with accompanying correspondence.

In reply, I beg to state that we have had no experiments on this line with the recently introduced continuous brake, but have watched with interest the experiments on other lines with a view to future action, should we find it desirable. In 1863, we adopted for all our through passenger trains Newall's patent brake, and have had it in use on these trains ever since. It is not fitted to engines, but nearly all our carriages are furnished with it. As you are no doubt aware the power is applied by the guard simultaneously with the application of the van brake. We have found it act well, and in the working of heavy trains over our long gradients it has proved of good service. Besides this, all our engines (with few exceptions) are fitted with steam brakes, which are also found useful.

As the question of brake power is of great importance, we are most anxious to secure for use the most efficient invention, and will be glad to co-operate with other companies in their efforts to obtain this.

I am, &c.,
(Signed) AND. DOUGALL.

Henry Oakley, Esq.,
Great Northern Railway, King's Cross,
London.

LANCASHIRE AND YORKSHIRE RAILWAY.

1, 2, and 3. Yes, with both Fay's and Newall's system of continuous brake, one or other of which has been generally adopted throughout the Lancashire and Yorkshire system. These continuous brakes have been in use on our lines for more than 20 years, and all passenger trains are fitted with and are controlled by them.

4. See account of experiments at Newark, detailed in Appendix F. of the Report of the Royal Commission on Railway Accidents.

4 (*a.*) These brakes are, as shown in the above experiments, efficient, but having to be applied by the guards by hand, are not so rapid in action as brakes actuated by steam, air, or other power mechanically applied and worked. These brakes are not self-acting in case of accidents.

4 (*b.*) There is no difficulty in putting on or taking off these brakes.

4 (*c.*) No difficulties have been experienced as regards maintenance.

5. Yes, engines and carriages for one complete train are being fitted with Westinghouse's automatic brake. Engines and carriages for one complete train are also being fitted with Smith's vacuum brake. Reports will be made three months after completion.

6. Two engines and eight carriages, Westinghouse automatic. Two engines and eight carriages, Smith's vacuum. The latter may be expected to be ready in one month's time, and the former in about six weeks.

7. Will be on trains running between Bacup and Manchester.

8. The officers of this company are in frequent communication with the officers of other companies on this matter, and information is freely interchanged as to relative experience.

LONDON, BRIGHTON, AND SOUTH COAST RAILWAY.

1. Yes, several experiments have been made.

2. *The Westinghouse*, *Barker's*, and *Edwards'*.

3. *Westinghouse*, on Company's main line between London and Brighton; *Barker's*, London and Victoria, viâ Crystal Palace; *Edwards'*, Hayward's Heath and Brighton.

4 (*a.*) *Westinghouse*, result satisfactory; *Barker*, result satisfactory; *Edwards'*, unsatisfactory.

4 (*b.*) *Westinghouse.*—In the hands of the driver with every facility for putting on and off.

Barker.—Worked by guard entirely, with equal facilities for putting on and off as Westinghouse.

Edwards.—Worked by guard entirely, the application of the brake both on and off is very slow.

4 (*c.*) The maintenance not being in our own hands, we are unable to express an opinion upon this point; as to durability, this we are also unable to express an opinion upon, which would be of any value, for the reason given above, viz. that the maintenance was not in our own hands.

5. No further experiments are contemplated at the present time.

6. No engines or carriages have been permanently fitted up with continuous brakes, but the engines are being fitted up with steam brakes of our own Locomotive Superintendent's (Mr. Stroudley), and which have been fitted to about 30 engines, and found to be very efficient.

7. No continuous brake in use at present.

8. None, since the experiments were made at Newark in the presence of the Royal Commission appointed on railway accidents.

LONDON, CHATHAM, AND DOVER RAILWAY.

Continuous Brakes.

ANSWERS to QUESTIONS contained in Railway Companies Association Circular, of the 21st April 1877.

1. Experiments have been made on this line with continuous brakes.

2. Westinghouse original compressed air continuous brake, and the Westinghouse improved automatic.

3. On the main line in 1874, with the original Westinghouse.

4 (*a.*) The results were satisfactory as regards efficiency in stopping trains, as the brakes could be applied instantaneously, but they were not self-acting in case of accident.

4 (*b.*) No difficulty experienced in putting on and taking off brake.

4 (*c.*) The maintenance would be expensive; the durability not thoroughly ascertained, as the system had not been long enough in work.

5. No further experiments are contemplated at present. A future report can be given on the Westinghouse automatic continuous brake now in use.

6. Four engines and 20 coaches are fitted with the automatic continuous brake.

7. The Westinghouse automatic brake is in use on the main line boat express trains, running daily (morning and night) between London and Dover, and return.

8. I am not aware of any steps that have been taken for comparing the experience of one company with that of another.

LONDON AND NORTH-WESTERN RAILWAY.

1. In 1862 experiments were tried on this line with Fay's continuous hand-worked brake; the license to use Fay's brake was purchased on 10th July 1863, when the Irish mail trains and the royal train were so fitted. This brake was next fitted in 1872 on the Metropolitan District trains, and remained in use till the company had fully satisfied themselves that the "Clarke" brake could be improved, and made more efficient and reliable, when it was superseded by Clarke's brake, of which the company purchased the right to use on the 9th December 1870.

After these trains had been fitted some time, it was considered advisable by the company to extend the use of continuous brakes to passenger trains generally, and the Clarke brake was still further altered and improved by Mr. Webb, in order to adapt it to main line traffic, and from that time to the present, as then altered and improved, it has been applied to the stock. The only other experiments were those asked for the Royal Commission on Railway Accidents, when this company sent a train completely fitted up with the latest improvements up to that time to Newark, the result being shown in the tabulated statement accompanying their report.

2. With the "Fay," the "Westinghouse," the "Clark and Webb," and the "Heberlein."

3. Previous to the trials, at the request of the Royal Commission on Railway Accidents, at Newark, on various portions of the line in actual work. (*See* answer 1.)

4 (*a.*) With the Clarke and Webb brake very satisfactory we consider. As regards their efficiency in stopping trains, we believe they are the most reliable of any mechanical means at present in use. The brakes can be applied instantaneously by the driver pulling the trigger cord, or by the guard releasing the trigger in the van. In the case of a train separating, so as to snap or stretch the trigger cord, it will put on the brake on as many sections as there are on the train; and, in the case of the engine and tender separating from a train, it will also put on the brakes in the same way, the trigger cord being attached to the engine or tender. The accident through the failure of a draw-bar at Newark, during the trials, proved the former case; and on two occasions at least since the brake was practically put to work, they have been effective when the engines and tenders have broken loose from trains going at full speed.

4 (*b.*) The brakes can be put on with great facility, either by the guards or drivers, but they can only be taken off by the guards. This we consider an advantage, as it prevents the brakes being used when there is no cause for doing so. We do not allow these brakes to be used for ordinary stoppages, preferring to use for that purpose the powerful manual brake with which each brake van and tender or engine is fitted, reserving the continuous brake as an extra means of stopping in case of emergency; the continuous brakes are, however, tested in ordinary work at the first station after leaving a terminus, to see that they are in order. (Printed instructions as to the working appended hereto.)

4 (*c.*) The durability of these brakes surpasses, in our judgment, any other continuous power brake now in use, and there is no difficulty in maintaining them.

5. We consider that we are now beyond the stage of experiment, and do not expect to make any further reports or experiments; but we shall from time to time make such alterations or improvements as experience suggests. The remainder of our stock, which requires fitting, will be done as rapidly as possible. (*See* answer 6.)

6. The engines require no special fittings. The company gave orders for the whole of their carriage stock to be fitted on a uniform system, as rapidly as possible, consistent with maintaining the service, either with the brake itself or with attachments that would enable the carriage to be put in any portion of the train. At the present time, out of a total stock of 4,840 vehicles, 943 have been fitted with the brake apparatus, and 712 with the attachments to enable the vehicles to be worked *in* the sections fitted with the continuous brake. The work is now being proceeded with regularly, by fitting the brake to the remainder of the stock. With this system of brake, carriages not specially fitted for the continuous brake can, and are being worked in the trains *between* any of the sections, without any particular preparation, beyond the running of the trip cord over the top. All the brake vans are fitted with powerful hand brakes, entirely separate and distinct from and in addition to the continuous brake, to be used for the ordinary stoppages of the trains, except on the Metropolitan District, and other heavy branches and gradients where the very frequent stops require special means. We have fitted up the engines working the Metropolitan District service, and are now fitting up the engines for working our heavy branches, with power brakes known as "Webb's hydraulic," which, in a very simple way, utilizes the water under pressure in the boiler for the putting it on, and the steam for taking it off. At the present time, 36 engines are so fitted. (*See* drawing.)

7. For some time past portions of all our main line trains have been fitted with continuous breaks in sections, and nearly all our branch lines where the gradients are heavy, the principle we have adopted for the carriages being the Clarke and Webb. (*See* drawing.)

8. The result of our experience has been freely given when asked for, and the brakes we are using are open to the inspection of the officers of any railway company who choose to apply to see them.

MEMORANDUM for GUARDS as to use of the PATENT CONTINUOUS BRAKE.

Many of the carriages are fitted up with the patent continuous brake, and are being run on the fast main line trains. The guards in charge of the trains are instructed carefully to observe its working, and to report any special circumstances arising in connexion with its use.

1. The lever for working the patent brake is distinct from the van brake, and though applied from the van, it does not act upon the wheels of the van itself.

2. For ordinary stoppages at roadside or terminal stations the van brake alone is to be used, except as stated in paragraphs Nos. 4 and 5.

3. The patent brakes are not to be put on for such ordinary purposes, or for stopping a train entering a terminal station, but the guards must be on the alert, *and apply them at once should the driver give the brake whistle,* or in the event of the train running past or being likely to run past a danger signal, or over-shooting a platform, or running too fast into a terminus, or in any case when they deem it necessary to pull up the train more quickly than could be done by the van brakes.

4. In order to insure the patent brakes being kept in good order for use on emergencies, and to test their being so, they are always to be applied, instead of the ordinary van brake for stopping the train at the *first* station at which the train is timed to stop, say Willesden Junction on the down journey.

5. If at any station the continuity of the chain which connects the brake has been interfered with by the separation of the train into sections, or the attaching or detaching of vehicles, the guards are to apply the patent brake at the next station at which the train is timed to stop.

6. If on any application of the brakes they are found not to be in perfect working order, and the defect cannot immediately be remedied by the guards, they must at once apprise the driver of the fact for his guidance.

7. In every case of the application of the patent brake, except at the first stopping station, *the reason for using it is to be entered in the guard's journals.*

8. The guards are to understand that the application of the patent brake is not to supersede the use of the ordinary brake, but that whenever circumstances arise which render it necessary to apply the patent brake, the ordinary van brake is also to be put on.

At the following stations there are men specially appointed to look after the patent brake apparatus, and any defect occurring in working must be pointed out to them by the guards immediately on arrival at any of those places, in addition to reporting the circumstance specially to the superintendent of the line:—Euston, Birmingham, Wolverhampton, Stafford, Crewe, London Road, Victoria, Liverpool, Holyhead, Carlisle.

Chief Traffic Manager's Office, (Signed) GEO. FINDLAY.
Euston Station, December 1875.

LONDON AND SOUTH-WESTERN RAILWAY.

1, 2, 3, and 4. The South-western Company have made no experiments with continuous brakes.

5. It is intended, as soon as practicable, to try experiments with a steam brake on the engine wheels, and Clarke's chain brake on some of the brake vans and carriages attached.

6. Fourteen engines have been fitted with steam brakes, and seven additional engines are now being so fitted. 12 other engines have been fitted with hand brakes. 110 brake vans have connected brakes, with additional carriages under Newall's patent; and 30 vans have connected brakes, with additional carriages under Clark's patent chain brake.

7. The brakes are in use upon several suburban and main line passenger trains.

8. We carefully study the experiments from time to time made and published, and other information obtained from other companies, and are waiting for additional experiments to be made by other companies and ourselves.

MANCHESTER, SHEFFIELD, AND LINCOLNSHIRE RAILWAY.

General Manager's Office, Manchester,
May 2nd, 1877.

DEAR SIR,

WITH reference to your circular in regard to the subject of brake-power, and the consultations which have recently been held between the officers of the Board of Trade and delegates from the Railway Companies Association.

I submitted this matter to my board at their meeting on Friday last, and now enclose for your information copy of a resolution passed by them on the subject.

You will be aware, of course, that the vacuum brake has been fitted to four of the express trains running each way between Manchester and London.

In addition to this, I may tell you that we have applied it to several of the local trains running over our own line, and we are now extending it to others.

Yours, &c.,
(Signed) R. G. UNDERDOWN.

Henry Oakley, Esq.,
London.

EXTRACT from the MINUTES of a meeting of the Board of Directors, held at Manchester on the 27th day of April 1877, SIR EDWD. W. WATKIN, M.P., in the Chair.

Mr. Underdown reported the negociations which had passed between the Board of Trade and the Railway Companies Association with reference to the question of brake-power, and it was resolved that the board, having adopted the vacuum brake, as on the whole the least objectionable, in their opinion, of the new brakes upon the continuous system, have nothing further to communicate, beyond their desire to place from time to time at the disposal of other companies, and of the Board of Trade, the results of their experience in extending the use of this brake.

They desire to remark, however, that having many years ago introduced continuous brakes, their experience at that time showed that new sources of danger were produced in practical operation, and they considered that on the balance of advantage it was necessary to remove, and the board did remove, such brakes.

METROPOLITAN RAILWAY.

1 and 2. This company has at various times tried the continuous brakes of Newall, Clarke's chain, and Smith's vacuum, with which latter all the trains are now working.

3. As early as 1865, and up to 1875.

4 (*a.*) With the brake adopted the brakes are applied, we may say, instantaneously. They are not self-acting.

4 (*b.*) They are put on by opening a steam cock, and released by opening a valve.

4 (*c.*) So far the cost has been very trifling for maintenance, the amount expended for repairs on 100 working carriages and 44 engines being only 20*s.* per week. Renewals have not yet been needed, except coupling hose; but no sign of renewals being required shows itself, although all have had nearly two years daily wear and tear.

5. No further experiments are contemplated, and, therefore, no further reports will be made.

6. All the stock of engines and carriages are fitted, viz., 44 engines and 180 carriages.

7. All trains—Smith's vacuum brake.

Midland Railway.

1, 2, and 3. The experiments with continuous brakes tried upon the Midland Railway have been as follows:

Date.	Brake.	Where tried.
April 1870 - -	Wilkin and Clarke's chain brake -	Birmingham and Gloucester Line, including Lickey, incline of 1 in 37.
March 1873 - -	Westinghouse air brake - -	Melbourne and Trent Line.
May 1873 - -	Ditto - -	Leeds and Bradford Line.
May 1873 - -	Ditto - -	London and Bedford Line.
April 1874 - -	Ditto - -	Ditto.
June 1875 - -	Ditto - -	Newark, under the direction of the Royal Commissioners on Railway Accidents; see their Report.
July 1875 - -	Westinghouse automatic brake -	Between Trent and Castle Donington.
September 1875 -	Ditto - -	London and Bedford Line.
May 1873 - -	Westinghouse air brake - -	Between Derby and Bedford.
March 1875 - -	Clarke's hydraulic brake - -	Derby, Trent, and Castle Donington Line.
March 1877 - -	Smith's vacuum brake - -	Ditto.

In addition to the above experiments, the following trains have, for the periods shown, been run with continuous brakes on the ordinary passenger train service of the company:

Between what Points worked.	Average Number of Trains per Day.	Commenced to run.	Discontinued.	Description of Brake.	Sets of Carriages.
Leeds and Bradford - -	8	October 1869 -	November 1869	Wilkin & Clarke's	
Bedford and London - -	2	November 1869	December 1869	Do.	
Leicester and London - -	2	May 1870 -	July 1870 -	Do.	
Leeds and Bradford - -	6	March 27, 1873	Nov. 7, 1874 -	Westinghouse air	1
Bedford and St. Pancras -	2	May 7, 1873 -	„	Do.	1
London and Manchester - -	2	March 15, 1874	Nov. 17, 1874 -	Do.	1
Bradford and London - -	2	Dec. 21, 187 -	April 30, 1876 -	Do.	1
Bradford and London - -	2	June 1, 1874 -	Nov. 7, 1874 -	Do.	1
Bedford and St. Pancras -	2	January 26, 1875	July 15, 1875 -	Do.	1
London and Manchester -	2	February 18, 1875	May 7, 1875 -	Do.	1
London, Manchester, and Liverpool - - - - -	2	April 1, 1875 -	May 18, 1876 -	Do.	1
Leeds, Bradford, Skipton, and Colne - - - -	8	August 12, 1875	June 16, 1876 -	Do.	1
Bedford, London, and Northampton - - - -	2	July 16, 1875 -	June 3, 1876 -	Westinghouse automatic.	1
St. Alban's, Luton, and London	2	Dec. 14, 1875 -	Still at work -	Do.	1
Bedford, Northampton, and London - - -	5	„	„	Do.	1
Luton and London - -	5	„	„	Do.	1
London and Carlisle - -	4	May 1, 1876 -	„	Do.	4
Leeds and Bradford - -	6	September 9, 1876	January 11, 1876	Barker's hydraulic	
Bedford and London - -	2	June 3, 1876 -	Still at work -	Do.	
Bedford and Northampton -	4	Nov. 10, 1876 -	„	Do.	

Records of the above experiments and of the regular working of the above trains have been kept by the company, and can be supplied to the Board of Trade if desired.

4 (*a.*) The detailed result of each experiment can be shown as stated above, if desired. All the brakes tested with the exception of Wilkin and Clarke's chain brake operate instantaneously. The Westinghouse automatic brake and Smith's vacuum brake are self-acting in case of accident, the others are not.

4 (*b.*) There is no difficulty with any of the brakes in this respect.

4 (*c.*) The "Westinghouse" and "Barker's" continuous brakes have entailed expense in maintenance in proportion to the machinery employed. We have not yet had experience of maintenance with "Smith's" brake, having only just commenced to try it.

5. It is intended to continue working the trains fitted with continuous brakes, as stated above. In addition two trains have been fitted with Smith's vacuum brake, and will be worked with the ordinary traffic between London and Manchester. Careful records will be kept of the working of these trains.

6. The following stock has been fitted with continuous brake apparatus :—

	Engines.	Carriages.
Westinghouse - - -	57	166
Smith - - -	6	29
Barker - - -	2	26
Clarke and Webb's - -	2	24

Three engines have been fitted up with steam brakes.

Fourteen family carriages have been fitted up with pipes, so that they can run with trains fitted up with the Westinghouse brakes, and 82 additional vehicles are in course of being fitted with the Westinghouse automatic brake, or pipes, to work with it; and 32 with Smith's vacuum brake, or pipes to work with it.

Six engines, in addition to those already completed are now being fitted with Smith's vacuum apparatus.

7. Continuous brakes are now in use at the present time on the under-mentioned trains :—

Train.	From	To	Description of Brake.
10.30 a.m.	London - -	Carlisle - -	Westinghouse automatic acts instantaneously, and is self-acting in case of accident.
9.15 p.m.	" - -	" - -	
12.10 a.m.	Carlisle - -	London - -	
1.10 p.m.	" - -	" - -	
9.25 a.m.	St. Alban's -	" - -	
6.30 p.m.	London - -	Luton - -	
8.5 p.m.	Luton - -	St. Alban's -	
9.15 a.m.	St. Alban's -	Bedford - -	
11.17 a.m.	Bedford - -	Northampton -	
2.5 p.m.	Northampton -	Bedford - -	
5.45 p.m.	Bedford - -	London - -	
9.35 p.m.	London - -	St. Alban's -	
6.25 a.m.	St. Alban's -	Luton - -	
7.30 a.m.	Luton - -	London - -	
10.35 a.m.	London - -	Luton - -	
4.0 p.m.	Luton - -	London - -	
7.35 p.m.	London - -	St. Alban's -	
2.57 p.m.	Normanton -	Leeds - -	
4.20 p.m.	Leeds - -	Normanton -	
7.45 a.m.	Bedford - -	London - -	Barker's hydraulic acts instantaneously, but not self-acting in case of accident.
4.40 p.m.	London - -	Bedford - -	
8.40 a.m.	Bedford - -	Northampton -	
9.52 a.m.	Northampton -	Bedford - -	
4.32 p.m.	Bedford - -	Northampton -	
6.25 p.m.	Northampton -	Bedford - -	
9.50 a.m.	Manchester -	London - -	Smith's vacuum brake acts instantaneously, but at present is not worked as self-acting, although it can be in case of accident.
3.15 p.m.	London - -	Manchester -	

8. Representatives of other companies have been invited, and have been present at experiments, and requests made for company's experience of actual working have always been freely and fully responded to.

THE NORTH BRITISH RAILWAY COMPANY.

Memoranda as to Brake Power.

1. The North British Company have tried experiments with continuous brakes, and have also conducted competitive trials under the direction of a committee consisting of the locomotive engineers of other railways.

2. The brakes tried were the Westinghouse automatic air brake, and Smith's vacuum brake.

3. They were tried on the North British Railway from Edinburgh to Glasgow, and *vice versâ* on the 22nd December 1876.

4. The following table shows the result:—

—	Smith's Vacuum.	Westinghouse Automatic.	Smith's Vacuum.	Westinghouse Automatic.	Smith's Vacuum.	Westinghouse Automatic.	Smith's Vacuum.	Westinghouse Automatic.	Smith's Vacuum.	Westinghouse Automatic.	Smith's Vacuum.	Westinghouse Automatic.	Smith's Vacuum.	Westinghouse Automatic.	Smith's Vacuum.	Westinghouse Automatic.	Smith's Vacuum.	Westinghouse Automatic.	Smith's Vacuum.	Westinghouse Automatic.
Speed of Trains. Miles per hour	30	30	40	40	40	40	40	40	49	49	49	49	50	50	54	54	55	55	56	54
Time occupied in running after application of brakes. Seconds	17·2	13·0	20·2	16·0	23·0	16·0	22·5	16·0	27·0	19·0	26·0	19·0	27·0	18·7	28·0	21·0	28·0	21·0	26·0	26·2
Distance run after application of brakes. Feet	480	328	740	550	860	550	810	550	1,250	798	1,175	798	1,195	777	1,310	952	1,375	910	1,172	1,158
Brake-power. Time per centage	0·75	1·00	0·79	1·00	0·69	1·00	0·71	1·00	0·70	1·00	0·73	1·00	0·69	1·00	0·75	1·00	0·75	1·00	Equal	Equal
Brake-power. Distance	0·68	1·00	0·74	1·00	0·64	1·00	0·68	1·00	0·64	1·00	0·68	1·00	0·65	1·00	0·73	1·00	0·76	1·00	Equal	Equal
Speed of trains after running 500 feet with brakes applied	–	–	27·5	17·0	32·5	16·5	31·25	16·5	46·75	35·0	44·0	35·0	44·25	33·5	48·5	40·5	50·0	39·0	45·0	43·25
After running 900 feet with brakes applied	–	–	–	–	–	–	–	–	35·0	—	30·0	—	31·0	—	36·25	15·0	38·25	7·0	28·25	28·5

4 (*a.*) The Westinghouse automatic air brake can be applied instantaneously and is self-acting. Smith's vacuum brake cannot be applied instantaneously with the same power, and is not self-acting in case of accident by train becoming disconnected, unless when provided with exhausting pumps in brake-van.

4 (*b.*) The Westinghouse automatic air brake can be put on and taken off so as to enable the engine-driver or guard to control the speed of the train with the greatest nicety.

Smith's vacuum brake can be put on and taken off with perfect ease by the driver only, the guard having no control unless the brake-van is fitted with an exhausting pump. When the brake is applied by the guard by the application of the air pump, the train cannot again be started until it is relieved by him, the driver having no control over it when so fitted, and communication between the engine-driver and guard to apply brakes is neither reliable nor safe.

4 (*c.*) Cannot yet speak as to the cost of maintenance or durability, neither brake has yet caused any trouble or expense beyond first cost.

5. No further experiments are contemplated on the North British Railway, as this company has adopted the Westinghouse automatic air brake as being, in their opinion, the best yet devised.

6. We have fitted up 15 engines and 100 carriages with the Westinghouse automatic air brake apparatus, and shall increase the number as may be required.

One engine and 10 carriages have been fitted with Smith's vacuum brake apparatus.

7. The Westinghouse brake has been in operation on the through Scotch express trains in connection with the Midland Railway, running between Edinburgh and Carlisle for nearly 12 months, and is now also fitted on trains run between Edinburgh and Glasgow, Glasgow and Helensburgh, Glasgow and Balloch.

8. Not aware of any steps being taken to have one uniform brake system adopted, as many of the railway companies are still experimenting with continuous brakes, but consider it very desirable that an uniform system should be adopted, as this would materially facilitate the interchange of coaching stock.

THE NORTH-EASTERN RAILWAY COMPANY.

General Manager's Office,
York, 28th April 1877.

Continuous Brakes.

ANSWERS to the questions of the BOARD OF TRADE contained in the communications addressed to GEORGE LEEMAN, Esq., M.P., by the Hon. EDWARD STANHOPE, M.P.

1. The North-eastern Company have made several experiments with continuous brakes.

2. Newall and Fay's, Westinghouse, Smith's vacuum, and the Heberlein brake.

3. Newall and Fay's brake has been working on several branch lines with heavy gradients for the last 15 years. The Westinghouse air brake was fitted to a train and was tried on the line between Newcastle and Berwick, in March 1874. This train was broken up and made into three trains, which have been working on several branch lines. One train was run between Newcastle and Consett and Durham, (gradients 1 in 60 and 1 in 66) from March 1874 up to the beginning of the present year, when the air brake was altered into the automatic brake.

Further experiments were made with this brake between Newcastle and Berwick, on March 22nd, 1876, and April 6th, 1876, when the results were as follows :—

RESULTS of EXPERIMENTS with WESTINGHOUSE AIR BRAKE on the NORTH-EASTERN RAILWAY.

Reference Number.	Weight of Engine.	Weight of Tender.	Weight of Carriages and Vans.	Total Weight of Train.	Number of Wheels fitted with Wooden Brake Blocks on one side only to which Brakes were applied during trial.	Number of Wheels fitted with Cast-iron Brake Blocks on one side only to which Brakes were applied during trial.	Total Number of Wheels in Train.	Total Number of Brake Blocks applied during trial.	Time occupied in running the distance, 880 yards, from point to point.	Corresponding speed in mile per hour.	Distance run after application of Brake.	Time occupied in bringing Train to rest.	Total work in foot tons performed by Brake.	Work in foot tons per second performed by Brake.	Reduced distance for 50 miles an hour.	Gradient on which train was brought to rest.	State of Rails.
	Tons cwts.	Tons cwts.	Tons cwts.	Tons cwts.					Seconds.		Feet.	Seconds.			Feet.		
1	35 3	24 17	169 16	229 16	22	64	86	86	40	45·	1,269	—	15,548	—	1,566	Falling 1 in 264	Dry
2	35 3	24 17	169 16	229 16	22	64	86	86	33	54·5	1,671	36	22,839	634·4	1,406	1 in 150	„
3	35 3	24 17	169 16	229 16	22	64	86	86	38	47·5	1,161	24½	17,181	702·2	1,286	1 in 377	„
4	35 3	24 17	169 16	229 16	22	64	86	86	33	54·5	1,839	33	22,839	692·	1,547	1 in 190	„
5	39 8	26 4	185 10	251 2	22	64	86	86	37	48·75	1,278	27	19,803	733·47	1,344	1 in 320	„
6	39 8	26 4	185 10	251 2	22	64	86	86	34½	52·25	1,521	29	22,489	789·1	1,392	1 in 220	„
7	39 8	26 4	185 10	251 2	22	64	86	86	34½	52·25	1,500	28½	22,489	789·1	1,373	1 in 150	„
8	39 8	26 4	185 10	251 2	22	64	86	86	30	60·	1,665	30½	30,170	989·18	1,156	Level	„
9	39 8	26 4	185 10	251 2	22	64	86	86	33	54·5	1,380	26½	24,924	940·53	1,161	Level	„
10	39 8	26 4	185 10	251 2	22	64	86	86	33	54·13	1,680	31	24,196	780·52	1,440	Falling 1 in 170	„
11	39 8	26 4	185 10	251 2	22	64	86	86	36	50·	1,299	27½	20,933	761·21	1,299	1 in 471	„

Experiments were also made with the Westinghouse automatic brake over the same ground, on the 28th February 1877, with a train consisting of 13 four-wheeled carriages, two four-wheeled vans, with engine and tender, with the following results :—

Results of Experiments with Westinghouse Automatic Brake.

Number of Experiment.	Speed in Miles per Hour.	Distance run in Feet after Brake Application.	Number of Seconds in Stopping.	Remarks.
1	40	575	15½	Level.
2	44	638	16¾	1 in 217 down.
3	51	820	19½	1 „ 150 „
4	52	850	—	1 „ 377 „
5	36	432	14¼	1 „ 490 „
6	52	912	21¾	1 „ 4,500 „
7	48	880	20¾	1 „ 381 „
8	42½	770	16½	1 „ 170 „
9	35	450	13¾	1 „ 600 up, steam on.
10	40	640	17	Steam on.
11	41	625	17	Ditto.
12	48	775	18	Ditto.

A train consisting of six carriages and two vans was fitted up with Smith's vacuum brake, and experimental trials were made with it on the East and West Yorkshire line, between York and Starbeck.

After these experiments the train was broken up, and the carriages were put to ordinary work.

On the 24th May 1876, experimental trials were made with a train consisting of eight six-wheeled, and four four-wheeled vehicles, fitted with Smith's vacuum brake, between York and Starbeck.

The results were as follows :—

RESULTS of EXPERIMENTS with SMITH'S VACUUM BRAKE on the NORTH-EASTERN RAILWAY.

Reference Number.	Weight of Engine.	Weight of Tender.	Weight of Carriages and Brake-vans.	Total weight of Train.	Number of Wheels fitted with Wooden Brake Blocks on one side only, to which Brakes were applied during trial.	Number of Wheels fitted with Cast-iron Brake Blocks on one side only, to which Brakes were applied during trial.	Total Number of Wheels in Train.	Total Number of Brake Blocks applied during trial.	The proportions of Weight on Brake Blocks to gross Weight of Train.	Time occupied in running the measured distance, with the equivalent speeds. 880 yards from Point to Point. Time in Seconds occupied in running the distance.	Time occupied in running the measured distance, with the equivalent speeds. 880 yards from Point to Point. Corresponding speeds in Miles per Hour.	Distance run after application of Brake.	Time occupied in bringing the Train to rest.	Total work in Foot Tons performed by Brake.	Work in Foot Tons per second performed by Brake.	Reduced distance for 50 Miles per Hour.	Gradients on which the Train was brought to rest.	State of Rails.	REMARKS.
	Tons cwts.	Tons cwts.	Tons cwts.	Tons cwts.					Tons cwts.			Yards.	Seconds.			Yards.			
1	33 15	28 1	157 4	219 0	6	68	76	74	2 19	32	56·25	434	25	23,143	926	342·9	Falling 1 in 1,200	Dry	Sand used and fireman at tender brake.
2	33 15	28 1	157 4	219 0	6	68	76	74	2 19	35	51·42	343	24	19,358	806	324·3	Level	Wet	
3	33 15	28 1	157 4	219 0	6	68	76	74	2 19	48	37·5	247	19½	10,284	528	439·1	"	"	
4	33 15	28 1	157 4	219 0	6	68	76	74	2 19	34	53·0	347	22½	20,530	913	308·8	Falling 1 in 174	"	
5	33 15	28 1	157 4	219 0	6	68	76	74	2 19	42	42·85	281	17	13,425	789	382·6	Level	"	
6	33 15	28 1	157 4	219 0	6	68	76	74	2 19	39	46·15	251	18	15,579	865	294·6	"	"	
7	33 15	28 1	157 4	219 0	6	68	76	74	2 19	44	41·0	251	32	12,242	382	294·6	Falling 1 in 130	"	No brakes on engine or tender used, those on the carriages applied with one pump in the leading van.

The Heberlein Brake was fitted to four carriages and two vans, on a train consisting of eight carriages and two vans, and was worked between Newcastle and Tynemouth for a considerable time.

4 (*a.*) *Newall and Fay's Brake* is effective in bringing ordinary trains up at stations, but cannot be considered an efficient brake in cases of emergency; neither is it well adapted for trains requiring to be broken up.

The Heberlein Brake.—This brake was found to be effective for the stopping of trains, but its working was not considered satisfactory as regards the sensations caused to passengers travelling in the train to which it was applied.

Westinghouse Brake and Smith's Vacuum Brake.—These brakes can be applied almost instantaneously.

4 (*b.*) No difficulty has been found in putting on or taking off the Westinghouse brake, or Smith's vacuum brake.

4 (*c.*) This question can only be answered after long experience in the working of brakes.

5. Yes, the North-eastern Company are fitting a train with the Westinghouse automatic brake, consisting of 13 carriages, 2 vans, and engine, with brake-blocks applied to both sides of the wheels under the vehicles. This train will be ready for trial in a fortnight from the present time.

The company are also fitting up a train with Smith's vacuum brake, with the latest improvements.

When further experiments have been made, the results can be reported.

6. *Westinghouse Brake :—*

Engines - -	3	Fitted with the automatic brake.
,, - -	1	In hand.
,, - - -	3	Fitted for working the ordinary air brake train.
	7	
Carriages - -	30	Fitted with the automatic brake.
,, - -	13	In hand.
	43	
Vans - -	6	Fitted with the automatic brake.
,, - - -	2	In hand.
	8	

Smith's Vacuum Brake :—

Engines - - - - -	1	Fitted up.
,, - - - -	1	In hand.
	2	
Carriages - - - -	6	In hand.
Vans - - - - -	2	In hand.

Newall and Fay's Brake :—

Carriages - - -	106	Fitted with the brake.
Vans - - -	55	Do. do.

7. This question is answered by the replies to the previous questions.

It may be added that the North-eastern Company have at present the Westinghouse brake and Newall and Fay's brake at work. The trains to which the former brake is applied are working between Newcastle, Consett, and Durham, Newcastle and Carlisle, and Newcastle and Berwick.

The North-eastern Railway being an intermediate line on the through route between England and Scotland, the company, in dealing with the question of continuous brakes, have not been in a position to do much more than test by experiment the efficiency of certain of the brakes which have been most prominently brought under notice.

The North-eastern line joins the Midland Company's line at Normanton, the Great Northern line at York, the London and North-western line at Leeds, the Lancashire and Yorkshire line at Normanton, and the North British line at Berwick.

Many of the North-eastern fast trains consist partly of carriages belonging to the companies with whom they are in connection, whilst the through express trains between England and Scotland consist almost exclusively of stock belonging jointly to the Great Northern, North British, and North-eastern Companies. The Great Northern Company have fitted some of their trains with Smith's vacuum brake; the Midland and North British have to a certain extent applied the Westinghouse brake, some of the Lancashire and Yorkshire carriages are fitted with Newall and Fay's brake, whilst the London and North-western Company appear to be most in favour of a mechanical chain brake, and interchanging stock as the North-eastern Company do with these companies it has been impossible to fix upon a particular description of continuous brake for general adoption on the North-eastern system, having regard to the different mechanical arrangements of the brakes of the companies above named.

There being, however, no immediate prospect of the introduction of a uniform system of brake power, it has been arranged to apply Smith's vacuum brake to the principal through express trains between King's Cross and Edinboro', and the Westinghouse brake will be applied to some of the other express or fast trains which are not materially affected by the interchange of carriages with other companies, and thus those two systems will before long be tested more fully by actual daily working.

In addition to the foregoing, the North-eastern Company have applied brakes to the engines and tenders which are used on their lines with express trains, thus greatly increasing the control of the engine-driver over the trains.

8. The results of the experiments have generally been communicated to the locomotive engineer of the Great Northern and North British Railways.

The North-eastern Company was represented at the trials of the Westinghouse brake, and Smith's vacuum brake on the North British Railway in December and January last.

The company have also had the question of continuous brakes discussed with the locomotive engineer of the Great Western Company, and the subject has been one of frequent communication between the officers of the North-eastern and those of other companies.

NORTH LONDON RAILWAY.

1, 2, and 3. Experiments have been carried out by this company with continuous brakes for the last 25 years. The trials have included "Miles' steam brake," "Jackson's hydraulic," "Clark's connected brake," "Chambers' connected brake," "Fay's connected brake," "Clarke's chain brake," "Chaffin's electric brake," and finally "Clarke and Webb's improved chain brake." Of the above, Clarke's chain brake was found to be generally best suited to our purpose, and was fitted about 12 years ago to all our trains. After various experiments, however, it was decided in February 1874 to substitute "Clarke and Webb's" improved brake, and the trains have been in course of fitting up to the present time.

4 (*a.*) It has been found desirable in order to prevent undue strain on the carriage couplings to apply an improved brake to the engines, and our engines are now fitted with Webb's steam brake, whilst Clarke and Webb's improved chain brake is applied to the carriages, the front portion of the train being connected with the leading van, and the after portion with the rear van. Under ordinary circumstances the train is worked by the engine brake, and brakes attached to the rear van only, but the driver has the means of putting on the front brakes, so that he has at command a reserve power to be used if required. The brakes can be applied instantaneously, but are not self-acting.

4 (*b.*) As regards efficiency, a train of 90 tons weight and engine of 43 tons can, by applying all the brakes on the level and travelling at a speed of 25 miles an hour, be brought to a stand in its own length. If travelling 20 miles an hour the same result can be obtained by applying one set of the train brakes only, and so in proportion according to the speed and gradient. The brake is put on by simply bringing a friction wheel in contact with the wheel of the brake-van and comes off of itself on the contact being broken.

4 (*c.*) These brakes have been in use for the last three years and excepting for renewal of brake blocks, have cost nothing for repair. The number of stops up to the end of February was 1,785,696. The original cost of fitting for the steam brake is 40*l.* per engine, including royalty, and for the improved chain brake 24*l.* per van, and 12*l.* per carriage.

5. The brake is found to answer so well for the purposes of this company, that no further experiments are in contemplation.

6 and 7. We have at present 23 trains running with the improved brake, the remainder having still Clarke's chain brake, for which the improved brake is in course of substitution.

8. The results obtained by this company in their experiments have been freely communicated to the other companies, and inspections have, at various times, been made by the officers of other companies interested.

NORTH STAFFORDSHIRE RAILWAY.

1. Yes.
2. Clarke's.
3. Have had one in constant use since July 1875 on this company's loop line passenger train.

4 (*a.*) This brake can be applied instantaneously if required; is not self-acting.
4 (*b.*) Can be put on and taken off with great facility.
4 (*c.*) Maintenance and durability satisfactory.

5. No further experiments contemplated at present.
6. See No. 3.
7. See No. 3.
8. This company have not taken any special steps.

NOTE.—All this company's passenger trains, with the exception of the one in No. 3 answer, are fitted with highly efficient slide brakes after the manner of Fay's continuous brake, and answer well. This company's whole system is under 200 miles, and may be described as made up of a number of short or branch lines. The stopping places are very numerous, and near each other. The Clarke's brake in use is efficient and safe, if carefully applied, but we have had complaints and claims for personal injury where it has been too quickly taken off. Our experience is, that for the purposes of this company the slide brake (after the manner of Fay's continuous brake) kept in good order will, and in fact does, answer every purpose.

SOUTH-EASTERN RAILWAY.

1. Experiments have been made with a continuous brake.
2. Smith's vacuum brake.
3. On the South-eastern Railway on 10th August 1874.
4. Result of trial shown on annexed statement. The maintenance and durability may be taken as favourable up to the present time.
5. It is not contemplated at present to make any further experiments.
6. Fourteen engines and tenders, and 73 carriages, have been fitted with the vacuum brake, and brake fittings are ordered for an addition of two engines and tenders, and 21 carriages; making, when fitted, a total of 16 engines and 94 carriages.
7. The vacuum brakes are fitted on the continental, tidal, and mail trains, and those ordered are for the Hastings express.
8. No steps have been taken by this company for making the experiments of one company available for another.

EXPERIMENTS with SMITH'S VACUUM BRAKE on SOUTH-EASTERN RAILWAY.

August 10th, 1874.

TRAIN fitted with vacuum brake. Six large vehicles weighing about 55 tons, three small vehicles weighing about 13 tons, coupled engine weighing about 40 tons. Total weight of train 108 tons. Left the Low Level, London Bridge, at 1.34 p.m.

Where pulled up.	Time occupied.	In what distance pulled up.	Speed per Hour.	Remarks.
Orpington (distant-signal)	35 seconds	About 350 yards	40 miles	Heavy rainstorm. Sand used.
Dunton Green	28 "	250 "	60 "	Falling gradient.
Sevenoaks Tunnel	28 "	464 "	50 to 60 miles.	
Hildenboro'	33 "	464 "	—	From a signal given by brake-van.
Tunbridge (down distant-signal)	21½ "	290 "	50 miles.	
Paddock Wood	32 "	300 "	55 "	
Between Paddock Wood and Marden	25 "	—	40 "	Signal given from front brake-van.
Staplehurst	23 "	—	—	Nearly stopped. Brake released to get into station.
Headcorn	24 "	—	—	Ran well up to station, and came to a dead stop before reaching platform.
Pluckley	1½ minutes	—	—	As an ordinary train pulled up at platform, and had to ease brake off.
Ashford	—	—	—	Ran in as if intended to pass station, and pulled up suddenly before passing lower end of station.
RETURN JOURNEY.				
Pluckley	1 min. 15 sec.	—	—	Steam shut off before reaching distant-signal. stopped just outside station.
Headcorn	22 seconds	522 yards	—	Steam kept on same as if using vacuum brake.
Staplehurst	1 min. 55 sec.	—	—	Ordinary stop, and pulled up at the platform in the usual way.
Paddock Wood	—	—	50 miles	Signal at danger. Shut off steam 500 yards from distant, and stopped dead 200 yards from stop signal.
Tunbridge	27 seconds	—	55 "	Blinding snowstorm. Ran with steam on until could see signal; pulled up 200 yards from stop signal. Signal at danger.
Sevenoaks	—	—	—	Used vacuum brake, and pulled up well clear of platform.
Chislehurst	36 seconds	350 yards	65 to 70 miles	Steam kept on till within 30 yards of L. C. and D. overbridge. Falling ground.
Grove Park (distant-signal)	26 "	120 "	50 miles	Supposed to sight a train crossing the junction, although signals at clear; stopped at stop signals, and 100 yards before would foul crossing.
Parks Bridge Junction	30 "	—	—	
New Cross	27 "	—	—	Steam kept on until reaching stop signal; train pulled up at middle of platform.

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LONDON:
Printed by GEORGE E. EYRE and WILLIAM SPOTTISWOODE,
Printers to the Queen's most Excellent Majesty.
For Her Majesty's Stationery Office.
[2644.—1750.—6/77.]